Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia - Social and Behavioral Sciences 47 (2012) 829 – 834

Procedia
Social and Behavioral Sciences

CY-ICER 2012

Fieldwork in geology: teachers' conceptions and practices

Joel Filipe de Barros [a] *, Patrícia Albergaria Almeida [b], Nunca Cruz[c]

[a]*Escola Básica e Secundária Professor Reynaldo dos Santos, Vila Franca de Xira, Portugal*
[b]*University of Aveiro, Research Centre for Didactics and Technology in Teacher Education, Aveiro, Portugal*
[c]*University of Aveiro, Department of Geosciences, Aveiro, Portugal*

Abstract

The learning of geology taught at secondary schools has undergone changes over time. Many researchers look for new strategies or try to reformulate the existing ones in order to improve the methods of teaching this subject and to contribute to the emergence of active, critical and assertive citizens. Fieldwork is an increasingly used strategy for integrated learning in the area of Geosciences. In this investigation, we sought to identify the type and frequency of fieldwork implemented by geology teachers. We also aimed at understanding the importance of fieldwork in the teaching of geosciences. For that purpose, a survey was drafted and answered by 16 Biology and Geology 11th grade teachers. Results show that the majority of teachers resort to fieldwork up to three times each year. Also, teachers understand that the most adequate type of fieldwork for this level of teaching is Problem Solving Fieldwork. However, the majority of the activities carried out by teachers show that they usually implement Directed Observation Fieldwork type. These results indicate that teachers need to receive training at the level of the implementation of problem solving fieldwork.

Keywords: Geology,fieldwork, teachers, conceptions, practices.

1. Introduction

The Geology taught in Portuguese Secondary Schools has undergone several changes over the years. Many researchers look for new strategies and reshape existing ones, which will ultimately help to improve learning and to educate active, critical and assertive citizens.

In the last Curricular Revision for Portuguese Secondary Education, which included both general and technological courses, the Ministry of Education defined guidelines such as the introduction of practical elements and the emphasis on experimental teaching. This methodology has played a pivotal role in the teaching of Sciences, and it is generally well accepted by teachers. Fieldwork is an increasingly used teaching and learning strategy, and enables an actual integrated learning of Geosciences.

Compiano (1991, p. 12) underlines the importance of fieldwork: *"we cannot lose sight of the role played by fieldwork as a source of knowledge. As practice, the field represents both the place where information is taken from for theorisation, as well as the place where those theories are tested."* In fact, fieldwork must be understood in the broad sense. Field trips must not be seen as mere site visits, rather as opportunities for direct contact with geology and the environment. Compiano (1991, p. 14) also stresses the pedagogical relevance of fieldwork in the teaching of

*Patrícia Albergaria Almeida. Tel.: 00 351 234 247129
E-mail address: patriciaalmeida@ua.pt

1877-0428 © 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Dr. Hüseyin Uzunboylu
Open access under CC BY-NC-ND license. doi:10.1016/j.sbspro.2012.06.743

Geosciences: *"the field can be a channel for knowledge, processes and concepts. It can generate problems but also be an integration agent for Geosciences, constructing a widespread vision of nature and environment."*

This study focuses on the importance of fieldwork in the teaching and learning of Geology. This paper reports only a part of a wider research project, carried out as part of a Masters in Biology and Geology Teaching.

This paper focuses on the importance of fieldwork, as well as on the type of fieldwork and how frequently teachers implement it. Thus, the aims of this paper are as follows:to understand the importance of fieldwork given by teachers;to understand the role played by fieldwork in the understanding of geological concepts;to ascertain how frequently secondary education teachers admit implementing fieldwork;to identify and to characterise the type of fieldwork implemented by secondary education Biology and Geology teachers.

The following sections present a brief review of the literature on fieldwork in the teaching and the learning of Geology, as well as a description of the methodology used. The final section will present and discuss results, conclusions and limitations.

2. Fieldwork

There are numerous references to fieldwork in the Secondary Education Portuguese Curriculum, especially regarding Geology, for instance, "analysing problem-based cases linked to regional planning and geologic risk"; "developing a geological heritage valorisation approach (Earth memory)".

Therefore, it is important to know the opinion of Biology and Geology teachers on the value of fieldwork and how frequently it should be implemented. Over the past years, researchers have shown an interest in this type of practical work. For instance, Dourado (2001) carried out a study which characterises conceptions and practices of teachers regarding practical work. The results show that teachers are satisfied with the way fieldwork is implemented. However, traditional classes are still predominant, and students have limited intervention at the initial stages.

Pedrinaci et al. (1994) and Del Cármen and Pedrinaci (1997) have classified fieldwork into four categories: Traditional Field Trip, Field Trip as an Autonomous Discovery for Students, Field Trip as a Directed Observation by the Teachers and Problem Solving Field Trips.

The teachers lead the *Traditional Field Trip* and the students do not have an active role. The teachers' main concern is to follow a plan and to orderly pass on knowledge to students, as directly and quickly as possible. This type of activity follows the transmission model. In this type of fieldwork, teachers plan the trip alone, and write an observation guidebook which is then distributed to students. During the field trip, teachers point out what to see, how to observe and register observations, and how to interpret information. This way, students absorb knowledge uncritically, and limit their activity to taking notes. The logic behind this type of work is that of an enclosed and outdated science.

Field Trip as an Autonomous Discovery for Students is a response to the transmission model of education. In this type of fieldwork, students play a central role. While Traditional Fieldwork limits learning to concepts, Field Trip as an Autonomous Discovery for Students emphasises procedures, values and attitudes. Thus, and after carrying out experiments with 10 to 14 year old pupils who had to make their own observations, collect pertinent data, etc, Pedrinaci et al (1994) concluded that the questions posed after the observations had not brought great progress in terms of knowledge of the visited site.

In the *Field Trip as a Directed Observation*, teachers carefully plan the trip, select observation points, define the types of observation in each site and how to register information. Also, teachers write a guidebook to hand out to students. However, teachers loose their central role to students during the field trip, when teachers become tutors. They then become responsible for helping students with any questions about the guidebook, and may even help answering questions. This model contains elements of the previous two – it gives students the responsibility of observing and reaching their own conclusions. They can use the guidebook as a substitute to teachers (Traditional Field Trip). For this type of fieldwork, the authors consider that sometimes students may not fully grasp why they should observe certain locations and objects instead of others. Often they are not aware of the relevance of the cases observed and criteria chosen. Students may even carry out activities without understanding their purpose, or how to

get to the conclusions intended by teachers. Nevertheless, and according to Pedrinaci et al. (1994) and Del Cármen and Pedrinaci (1997) these problems can be easily overcome, resorting to preparation work with the observation guidebooks so that students can be made aware of the objectives of these activities. In spite of the limitations of this type of fieldwork, and according to the aforesaid authors, the trips will only have successful outcomes with motivated students and when there is enough time to carry out the activities.

Problem Solving Fieldwork attempts to overcome some of the difficulties and limitations of the previous models. It encompasses three moments: before the trip (formulation of a problem, which students answer through conceptual or empirical research); the trip (This activity stimulates reflection and improves reasoning through the justification of statements leading to new questions) and after the trip (students and teachers reflect on the different stages of the process.

3. Methodology

This research is both quantitative and qualitative, and data was collected through indirect observation. 10th and 11th years Biology and Geology teachers answered a survey, during the academic year 2009/2010.Teachers were required to give personal information (age, gender, qualifications) and how frequently they resort to fieldwork. They were also asked to point out which elements of the syllabus were pertinent for implementing fieldwork and to describe an activity they had carried out.

The surveys were administrated directly and indirectly (Quivy e Campenhoudt, 1998), and comprise both closed and semi-closed questions, as well as open questions. Two strategies were adopted for processing the answers. With regards to closed and semi-closed questions, categories were previously defined, whereas no such categories were defined for open questions. In this case, the surveys were read, and then answers were analysed and categories were defined (Ghiglione e Matalon, 1995).

During the academic year 2009/2010, 16 Biology and Geology teachers working in Oporto, Portugal, were invited to participate in this study. All accepted the invitation and answered the survey about fieldwork in the teaching and the learning of Geology.

4. Results and discussion

With regards to the first question, asking how frequently fieldwork is implemented for Biology and Geology it is possible to verify that the majority of respondents implements fieldwork as an educational strategy (62,5%), one or three times a year. No teacher implements fieldwork more than four times each year.Considering previous studies carried out byRebelo and Marques (2000) and Dourado (2001), the results presented contradict these authors. However, it is important to emphasise that previous studies dealt with larger samples. What in fact happens, and considering the literature, is that the percentage of teachers who do not resort to fieldwork as an educational strategy is higher than those who do. Thus, it can be generally accepted that the majority of the respondents, which contradicts most of the studies dedicated to this subject, selects these activities.

Given the classification proposed by Dourado (2001), the reasons stated for not implementing fieldwork by teachers were divided in three main groups (Table 1).

Table 1. Reasons stated for not implementing fieldwork (n=6)

Reasons		Frequency (f)	Percentage (%)
Teachers' Difficulties	Lack of field trip experience	3	50,0
	Unruly and unmotivated students	1	16,6
Syllabus and school management difficulties	Extensive syllabus	5	83,3
	Lack of cooperation by the members of the school council	2	33,3
Logistic and financial difficulties	Fieldwork complexity and organisation	3	50,0
	Distant location of adequate sites	2	33,3
Others		4	66,6

The difficulty most often stated by teachers for not implementing fieldwork is the extension of the syllabus (83,3%). Nieda (1994) had also mentioned it was one of the causes for not carrying out fieldwork. Lack of fieldwork experience (50%) and the complexity of its organisation (50%) are also stated as reasons for not resorting to this kind of strategy. Pedrinaci et al. (1994) also mentioned the organisation difficulties as an obstacle to the implementation of fieldwork. Other reasons include the need for parental authorisation for leaving the school during classes' time, and the fact that students miss other classes. These reasons may be included in the category "syllabus and school management difficulties".

The third question of the survey asked teachers to suggest ways of improving fieldwork implementation. In this question most teachers indicated that to improve the performance of fieldwork it was necessary to decrease the number of students per class (56.3%), followed by the cutback of program content (50%), training in fieldwork (43.8%), and the cooperation of other teachers (31, 3%).These results show consistency with those of the previous question, since the reasons stated link with extensive syllabus, lack of experience in fieldwork, organisation complexity and lack of teachers cooperation for this type of activity.

Teachers were also asked to state how the guidebook should be used. The majority of teachers (75%) believe they should suggest the guidebook. However, 68,7% stated that they should also write it, as opposed to 6,3% of the respondents who think the guidebook should be based on textbooks. Only 25% of respondents think teachers and students should jointly write the guidebook. No respondent believes students aided by teachers should write the guidebook, and all respondents think the guidebook should be used in fieldwork activities.

The majority of teachers (56,3%) believe fieldwork should be carried out by students in small groups. Nevertheless, 18,8% of respondents believe that teachers should ensure implementation and students should remain as observers. 6,3% of respondents refer that students should be individually responsible for implementation. The same percentage states that the activity "*should be implemented individually by students, under the teacher's guidance*".

Given the results presented, and considering the classification proposed by Pedrinaci et al. (1994) and Del Cármen and Pedrinaci (1997) regarding different types of fieldwork, it is possible to conclude that respondents believe the type of fieldwork they implement is Problem Solving Fieldwork. Respondents also believe that this is the most adequate method. The majority (56,3%) believes students organised in small groups must implement it. Nevertheless none of the respondents mentions that the guidebook must be written by students aided by teachers, and rather written by teachers and students.

Also, 18,8% considers teachers aided by students must ensure fieldwork implementation - Directed Observation Fieldwork. This is reinforced by 68,7% of respondents stating that guidebooks must be suggested and written by teachers. However, only 12,5% of respondents considers that teachers must ensure implementing the procedure, and students must remain observers, which fits into Traditional Fieldwork.

Teachers were also asked to state the reasons for using this strategy as a didactic resource. Basically, teachers give three reasons for implementing fieldwork as an educational strategy. The most mentioned reason is understanding the concept (80%) ("*During field trips students have the opportunity of visualising and consolidating an important share of the concepts taught in the classroom*"), followed by the contact with geological phenomena and on site knowledge (70%) ("*Science, especially Geology, must be understood and as such only an on site field activity will make that possible*"). Students' motivation comes last with 50% ("*contact with reality becomes more appealing...*").

Finally, teachers were asked to describe a field activity which they had carried out. In general, the great majority stated that teachers themselves prepared field trips on the previous day, informing students about the selected location, choosing sites where observations would take place and what type of observations, as well as how registration should be carried out. These elements were appropriately registered in the guidebook written by the teachers who would then hand it out to students. During the field trip, students perform their tasks planned in the guidebook, and once the trip was over students had to write a report with all the work they had done. Excerpts of the answers given by the teachers clarify of which type of fieldwork was used: *"Initially I approached the subject in the classroom, wrote a guidebook about what was going to be observed and wrote pertinent questions in the actual guidebook (...) during the visit students had the opportunity to use the knowledge previously acquired in the*

classroom (...)"; "The guidebook was written by myself (...) and included several stops where students answer questions previously written by me and performed their tasks (...)"; "(...) the activity began in the classroom, where students acquired the necessary knowledge before the visit (...) during the field trip students filled in a field guidebook with a set of questions about different stops (...)"

Although the majority of teachers implemented a Directed Observation Fieldwork, they considered the Problem Solving Fieldwork the best method.

5. Conclusions, implications and limitations

This study generally concludes that, for the sample studied, the percentage of teachers implementing fieldwork is higher than the percentage which does not. Furthermore, the difficulties expressed by teachers for not implementing fieldwork are essentially due to the extensive syllabus as well as the organisation complexity of fieldwork and the lack of teachers' experience in this type of activity. Teachers suggest reducing the number of students per class or splitting large classes, reducing extensive syllabus and attending training on fieldwork. These suggestions coincide with the reasons stated for not implementing fieldwork. With regards to the guidebook, the majority of respondents believe it should be suggested and written by the teachers. Considering procedure implementation, teachers think that students in small groups should carry it out. Thuss, the type of fieldwork most often used by teachers is Directed Observation, despite considering that Problem Solving is the best method. In 2001, Dourado warned for the need to rethink ways of implementing fieldwork and benefit from its use. More recently, Nunes and Dourado (2009) once again emphasised the importance of how fieldwork is implemented. Finally, the reasons pointed out by teachers for implementing fieldwork are: increasing students' motivation, helping to better comprehend concepts and to contact with geological phenomena and on site knowledge. The main limitation of this study is the small sample, as well as the fact that all teachers work in the same geographical area. This way, it would be pertinent to increase the sample in future researches, both in number of teachers and the location of the schools where they teach. Looking into the outcomes of this research, Geology teachers should receive more initial and in-service teacher training, in order to keep them up to date with innovative teaching strategies. In using these practices, teachers would be helping students to learn concepts, develop skills and improve their behaviour. Institutions should therefore create opportunities so that science teachers can help change attitudes and values, and raising an interest for science amongst students.It would also be pertinent to observe Geology field trips, in order to gain a better understanding of fieldwork activities.

References

Brusi, D. (1992). El treball al camp en ciències naturals [Fieldwork in natural sciences]. In Geli de Ciurana, A. M. e Terradellas i Piferrer, M. R. (Eds.), *Reflexions sobre l'ensenyament de les ciències naturals [Reflexions about natural sciences teaching] (pp. 157-194)*. Barcelona: Eumo Ed.

Compiani, M. (1991). A relevância do trabalho de campo no ensino de Geologia na formação de professores de Ciências [The relevance of fieldwork in the teaching of Geology in the training of science teachers]. *Cadernos do IG/UNICAMP*, 1, 2-25.

Del Cármen, L. &Pedrinaci, E. (1997). El uso del entorno y el trabajo de campo [The use of the environment and the fieldwork]. In L. Cármen (Coord.), *La enseñanza y el aprendizaje de las ciencias de la natureza en la educación secundaria [Teaching and learning natural sciences in secondary teaching] (*pp.133-154). Barcelona: Universitat Barcelona e Editorial Horsori.

Dourado, L. (2001). O trabalho prático no ensino das Ciências Naturais: situação actual e implementação de propostas inovadoras para o trabalho laboratorial e o trabalho de campo [Practical work in the teaching of Natural Sciences: present situation and implementation of innovative proposals for laboratory work and fieldwork]. *Unpublished PhD thesis*. Braga: Universidade do Minho, Portugal.

Ghiglione, R. & Matalon, B. (1995). *O inquérito – teoria e prática [Inquiry – theory and practice]*. Oeiras: Celta Editora.

Nieda, J. R. (1994). Algunas minucias sobre los trabajos prácticos en la Enseñanza Secundaria [Some minutiae of practical work in Secondary Teaching]. *Alambique. Didáctica de las Ciências,* 2, 15-20.

Pedrinaci, E., Sequeiros, L. & Garcia de la Torre, E. (1994). El trabajo de campo y el aprendizage de la Geologia [Fieldwork and learning Geology]. *Alambique. Didáctica de las Ciencias*, 2, 37-45.

Quivy, R. & Campenhoudt, L. V. (1998). *Manual de investigação em Ciências Sociais [Research book about social sciences]*. Lisboa: Gradiva.

Rebelo, D. & Marques, L. (2000). *O trabalho de campo em geociências na formação de professores: situação exemplificativa para o Cabo Mondego [Fieldwork in Geology teacher training]*. Aveiro: Universidade de Aveiro.